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ABSTRACT

A curriculum guide, in outline form, for oceanography field laboratories is presented. Designed to complement and expand upon an oceanography lecture course, it provides a list of objectives related to student experiences in three areas: (1) operating oceanographic equipment; (2) gathering, manipulating, and evaluating data; and (3) writing formal research reports. Specific units covered include: temperature and salinity measurements, bottom profiling, surface and subsurface current measurements, library research, writing a research paper, and biological sampling. Lists of laboratory equipment and teaching aids, texts and references, student handouts, assignments, and a term project description are included in five appendices. (DC)

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CURRICULUM OUTLINE

FOR A

GENERAL OCEANOGRAPHY FIELD

LABORATORY

(REVIEW CYCLE-ANNUAL)

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MISSION: The objective of the oceanography field laboratories are to facilitate development of beginning students expertise in the oceanography field beyond that acquired during enrollment in an oceanography lecture course. They further are intended to provide students experience operating oceanographic equipment, gathering, manipulating and evaluating data and writing formal research reports.

SCOPE: The laboratory sessions deal with the following areas of endeavor; (1) library literature search; (2) use of Nansen bottles, bathythermograph, current drogues, remote current sensing meter, recording fathometer, wire angle indicator, equipment depth recording guage, position determining equipment; rock drag, otter trowl; (3) collection of oceanographic data; (4) manipulation of oceanographic data and; (5) hydrographic description of a marine area; (6) collection of biological samples.

TERMINAL BEHAVIORAL OBJECTIVES: When a student has completed this project, he or she should be able to:

UNIT: 1.0 Temperature and Salinity Measurements

1.1 USE a bathythermograph.

1.1.1. INSERT a glass slide in accordance with directions provided in Hydrographic Office Publication (H.O.) 607.

1.1.2. COMPENSATE for surface temperature using directions from H.O. 607.

1.1.3. LOWER and RAISE a bathythermograph using guidance from H.O. 607.

1.1.4. READ a bathythermograph slide using guidance from H.O. 607.

1.1.5. RECORD slide data at two meter intervals.

1.2. USE Nansen Bottles

1.2.1. INSTALL reversing thermometers as described in H.O. 607.

1.2.2. ATTACH a string of Nansen bottles to a cable in the fashion described in H.O. 607.

1.2.3. COMPENSATE bottles for temperature as outlined in H.O. 607.

1.2.4. TRIP bottles following directions provided in H.O. 607.

1.2.5. READ reversing thermometers in a manner outlined in H.O. 607.

1.2.6. DRAW water samples following directions in H.O. 607.

1.3. USE equipment wire depth gauge.

1.3.1. LOWER equipment to a predetermined depth.

1.4. USE a wire angle indicator.

1.4.1. CALCULATE equipment depth using trigonometric principles discussed in any basic trigonometry text.

1.5. LOCATE research station position.

1.5.1. MANIPULATE either a handbearing compass or a stadimeter to determine lines of position using directions provided in Dunton.

1.5.2. PLACE lines of position on a National Ocean Survey using a parallel ruler or paraline protractor and principles set forth in Dunton's Navigation and Piloting.

1.5.3. DETERMINE longitude and latitude using dividers and principles outlined in Dunton's Navigation and Piloting.

1.6. KNOW how to determine salinity.

1.6.1. USE an inductive type salinity meter in accordance with directions provided in the equipment instruction book.

1.7. KNOW how to construct isohalines.

1.7.1. PLACE salinity data from various stations on an X-Y coordinate graph.

1.7.2. CONNECT points of equal salinity.

1.8. KNOW how to construct isotherms.

1.8.1. PLACE temperature data from various stations on an X-Y coordinate graph.

1.8.2. CONNECT points of equal temperature.

UNIT: 2.0 Bottom Profiling

2.1. CREATE a bottom profile.

2.1.1. USE remote depth sensing equipment in a manner outlined in the instruction book.

2.2. LOCATE profile track line.

2.2.1. MANIPULATE either a handbearing compass or a stadimeter according to the directions provided by Dunton's Navigation and Piloting.

2.2.2. MAKE running fixes with a handbearing compass using directions provided by Dunton's Navigation and Piloting.

2.2.3. PLACE starting and ending points and running fixes on a National Ocean Survey Chart using a parallel ruler or paraline protractor and principles set forth in Dunton's Navigation and Piloting.

2.2.4. DETERMINE longitude and latitude using dividers and principles set forth in Dunton's Navigation and Piloting.

2.3. KNOW how to correct a profile to reflect mean high or mean low water.

2.3.1. USE National Ocean Survey publication, tide tables to determine tide height at a specific time.

2.3.2. APPLY tidal height data to a bottom profile.

UNIT: 3.0 Surface and Subsurface Current Measurements

3.1. USE drogues to determine surface current speed and direction.

3.1.1. RECORD drop time.

3.1.2. DETERMINE longitude and latitude of the drop position using principles outlined in UNITS 1 and 2.

3.1.3. RECORD pickup time.

3.1.4. DETERMINE longitude and latitude of pickup location using principles outlined in UNITS 1 and 2.

3.1.5. CALCULATE elapsed time.

3.1.6. CALCULATE distance travelled using dividers and method outlined in Dunton.

3.1.7. CALCULATE current speed using the formula; RATE = DISTANCE TRAVELLED/ELAPSED TIME.

3.2. USE a remote current sensing meter to determine current speed, direction and water temperature at 5 feet intervals in a water column.

3.2.1. DETERMINE longitude and latitude of the station location using principles outlined in UNITS 1 and 2.

3.2.2. OPERATE a remote current sensing meter according to the directions provided in the equipment instruction book.

3.2.3. DETERMINE equipment depth using a depth gauge and the principles set forth in UNIT 1.

3.2.4. DETERMINE corrected equipment depth using a wire angle indicator and the principles set forth in UNIT 1.

3.3. KNOW how to determine current speed and direction at any given moment in the research area.

3.3.1. USE National Ocean Survey, tidal current tables to determine current speed and direction at a specific time.

UNIT: 4.0 Library Research

4.1. KNOW how to find project related literature.

4.1.1. USE a card catalog according to directions provided by a librarian.

4.1.2. USE abstracting services following directions provided in service publications and those provided by a librarian.

UNIT: 5.0 Writing a Research Paper

5.1. KNOW how to use proper format.

5.1.1. OUTLINE each section of the research paper using standard outlining procedures discussed in introductory English texts.

5.1.2. WRITE proper information in each report section using guidance provided by an oceanography instructor.

5.2. KNOW how to present data in figures and tables.

5.2.1. USE proper titles and numbers.

5.2.2. ARRANGE data so as to reflect trends.

5.3. KNOW how to cite properly published literature.

5.3.1. CITE work in context.

5.3.2. CITE work in References section of a paper.

5.4. KNOW how to write present material so that a project is reproducible.

5.4.1. REPORT stations accurately.

5.4.2. REPORT data collection methods adequately and accurately as directed by the committee on Form and Style, CBE Style Manual (third Edition), Washington, D.C.: American Institute of Biological Sciences, 1972.

5.5. WRITE a research report that is scientifically accurate.

5.5.1. USE a title which describes a research project adequately.

5.5.2. PRESENT project rationale.

5.5.3. DESCRIBE history of the problem.

5.5.4. DRAW conclusions based upon and supported by data and other research.

5.5.5. DISCUSS adequately, various parameters investigated during data gathering phases of a project.

5.6. KNOW how to apply the proper rules of grammar.

5.6.1. USE proper sentence structure as presented in contemporary English texts.

5.6.2. USE third person.

5.6.3. USE past tense.

5.6.4. CAPITALIZE properly.

5.7. KNOW how to spell words correctly.

5.7.1. MAKE no more than three spelling errors.

UNIT: 6.0 Biological Sampling

6.1. KNOW how to gather samples with a rock drag.

6.1.1. Use a rock drag in accordance with guidance presented by an oceanography instructor.

6.2. KNOW how to gather samples with an otter trawl.

6.2.1. FASTEN an otter trawl correctly to a tow line.

6.3. KNOW specimens gathered with a rock drag and otter trawl.

6.3.1. IDENTIFY organisms by kingdom.

6.3.2. IDENTIFY organisms by phylum.

6.3.3. IDENTIFY organisms by class.

6.3.4. IDENTIFY organisms by order.

6.3.5. IDENTIFY organisms by common name in accordance with information presented in Smith, R.I. Keys to the invertebrates of the Woods Hole Region.

LABORATORY TIME SUMMARY

I. Laboratory Introduction including discussion of research paper, 80 minutes.

II. Laboratory Conduct.

	TEACHING METHOD					
UNIT NUMBER	*LAB	PE	L	E	UDG	TOTAL
1.0		60	20	20	90	190
2.0		60	20	20	90	190
3.0		60	20	20	90	190
4.0		240				240
5.0		480				480
6.0	110		20	20	90	240
TOTALS	110	900	80	80	360	1530

*LAB = laboratory; PE = practical exercise; L = lecture; E = examination; UDG = underway data gathering.

III. Laboratory Length.

Introduction minutes + teaching minutes

80 + 1530 = 1610/60 = 26 5/6 hours

APPENDIX A

List of laboratory equipment and teaching aids.

The equipment listed here is considered essential if the laboratory is to be conducted in a manner which leads students to manifest minimum competency with the behavioral objectives.

1. Chalk
2. Chalkboard
3. National Ocean Survey Chart 13309 (one per student)
4. Parallel rulers or paraline protractor (one per student)
5. Dividers (one per student)
6. Research vessel
7. Hand bearing compass or stadimeter
8. Salinometer
9. Winch (research vessel mounted).
10. Water bottles (BOD type), at least 3 per class section.
11. BOD bottle carrying rack.
12. Bathythermograph (BT)
13. BT slides, at least 2 per class section.
14. BT slide reader.
15. Nansen bottles (3) with reversing thermometer frames.
16. Reversing thermometers (3).
17. Reversing thermometer reader.
18. Nansen bottle messengers (3).
19. Recording fathometer.
20. Wire angle indicator and or a wire meter wheel.
21. Current drogues (6).
22. Remote reading current meter.
23. Paper.

24. Pencils
25. Otter trawl.
26. Rock dredge.
27. Buckets (5).
28. Sorting trays (minimum 6).
29. Storage jars (approximately 24).
30. Formaldehyde (10% solution).
31. Check list of marine phyla.

APPENDIX B

List of Texts and References

1. Smith, R.I. Keys to the Invertebrates of the Woods Hole region. Woods Hole, MA: Systematics-Ecology Program, Marine Biology Laboratory, 1964.

2. Miner, W.R. Field book of seashore life. New York: G.P. Putnam's Sons, 1950.

3. Gosner, K.L. Guide to identification of marine and estuarine invertebrates. New York: Wiley-Interscience, John Wiley & Sons, Inc., 1971.

4. U.S. Department of Commerce tidal current tables Atlantic Coast of North America. Rockville, MD: National Ocean Survey.

5. U.S. Department of Commerce tide tables. Rockville, MD: National Ocean Survey.

6. U.S. Department of Commerce United States coast pilot. Rockville, MD: National Ocean Survey.

7. U.S. Department of Commerce Instruction manual for obtaining oceanographic data, (H.). 607). Rockville, MD: National Ocean Survey.

8. Maloney, E.S. Dunton's Navigating and Piloting. Annapolis, MD: U.S. Naval Institute, 1978.

9. Committee on Form and Style CEB Style manual. Washington, D.C.: American Institute of Biological Sciences, 1972.

10. Schlenker, R.M. and Perry C.M. A writing guide for student oceanography and marine biology field research reports, Castine, ME: Maine Maritime Academy.

11. Haefner, P.A. Hydrography of the Penobscot river (Maine) estuary. Journal Fisheries Research Board Canada, 1553-1571,24 (7), 1967.

12. Hatch, R.W. Temperature, dissolved oxygen and salinity data for the Penobdcot river, 1966-1970. Bangor, ME: University of Maine Water Resources Center, 1971.

13. Cronin, L.E. The role of man in the estuarine process. A reprint from American Association for the Advancement of Science publication Estuaries edited

by G.H. Lauff, AAAS publication No. 83, Washington, D.C. pp. 667-689.

14. U.S. Department of the Interior Report on Pollution--navigable waters of the Penobscot river and upper Penobscot bay. Federal watch Pollution Control Administration, Northeast Region, Merrimack River Project, Boston, MA, February 1967.

15. Bowdoin College A description of the near shore oil spill control project proposed for long cove, Searsport, ME. Brunswick, ME, Bowdin College Marine Research Laboratory, March 2, 1981.

16. Dyer, K.P. Estuaries: A physical introduction. New York: John Wiley & Sons, 1973.

17. Lauff, G.H. Estuaries. Washington, D.C.: American Association for the Advancement of Science, Publication No. 83, 1967.

18. Carson, R. The edge of the sea. Boston, Houghton Mifflin Company, 1955.

19. Williams, J. Oceanography, Boston: Little Brown and Company, 1962.

20. Officer, C.B. Physical oceanography of estuaries (and associated waters). New York: John Wiley & Sons, 1976.

21. Nichoul, J.C. J. Hydrodynamics of estuaries and fjords. New York: Elsevier Scientific Publishing Company, 1978.

APPENDIX C

List of Student Handouts

UNIT	HANDOUT NUMBER	TITLE
1.0	1-1	Hydrographic temperature and Salinity Sampling
1.0	1-2	Hydrographic Data Form
1.0	1-3	Nautical Charts, Plotting and Navigation
2.0	2-1	Bottom Profiling
3.0	3-1	Current Measurement
6.0	6-1	Marine Life Forms
6.0	6-2	Check List of Marine Phyla

APPENDIX D

List of Assignments

UNIT	TITLE
1.0	Nautical Charts, Plotting and Navigation.
2.0	Using tide tables.
3.0	Using current tables
5.0	Research Paper.

APPENDIX E

Term Project Description

The term project as designed includes at least four phases. They are data gathering, data analysis, library research and scientific report writing. It is conducted according to the following scheme. The oceanography class has been divided into ten or more field laboratory sections. Each section participates in a field lab session every two weeks. During a six week period, each lab section will gather; (1) water temperature and salinity data; (2) bottom profile data, and; (3) current data. At the completion of each laboratory exercise (1, 2, 3), the lab instructors will compile, reproduce and distribute all data gathered by all students for that exercise. Each student will receive three sets of data. Students use the data and proceed as described below.

Data gathered during the field laboratory sessions become the point of departure as each student writes a research paper. Each student's objective in writing the paper is to describe hydrographically, in a scientific manner, the area from whence the data were collected. In so doing, each student is expected to consult published texts and papers dealing with estuaries and to compare his or her data with that in the literature.

The final portion, writing the paper, is the last step in the process. The paper is composed in accordance with other guidance and written material provided by the laboratory instructors.